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Determination of the Longitudes of Berlin, Munich, Leipzig, Vienna, Paris, and Pulkowa.

(*Communicated by Sir G. B. Airy, Astronomer Royal.*)

In the summer of 1876 an expedition was organised by Herr Theodor von Oppolzer for determining the difference of longitude between Greenwich on the one hand and Berlin and Vienna on the other hand. The plan of operations, the selection of instruments, and the course of telegraphic communication were entirely arranged by Mr. Oppolzer. Huts for the instruments and for the galvanic apparatus, piers of masonry, &c., were prepared in the "magnetic ground" of the Royal Observatory, under the sanction of the Treasury Department. Three gentlemen were sent from Vienna to Greenwich, corresponding (I presume) in their observations with three observers at Vienna, and when a first series of observations was terminated (which, under the rigorous conditions of simultaneous observation, occupied a long time), the observers were interchanged. The instruments used for the observations of time were: a transit instrument upon a solid basis, adjusted to the meridian in the usual way; and a transit instrument on a rotatory basis, adjusted so that in its quasi-meridional movement it described a vertical great circle passing through the pole-star. On their chronographs, wire communications, &c., I am unable to speak with perfect accuracy. At Vienna and at Greenwich the difference of longitude of the observing stations was supplemented by geodetic calculations in order to obtain the difference of longitude of the transit instruments of the two Observatories.

Within a few days I have received from Mr. Oppolzer a statement of the final results of the operation. It contains (among other things) a comparison of chronometric with galvanic results. I have pleasure in communicating a translation of Mr. Oppolzer's letter to the Royal Astronomical Society.

G. B. Airy.

1879, *May* 13.

Translation of Letter from Dr. Oppolzer to the Astronomer Royal, dated Vienna, 1879, May 1.

I am at last in a position to communicate to you further results for the difference of longitude between Greenwich and Vienna.

Greenwich Transit Circle—Vienna, eastern pier:—

h	m	s	
1	5	21·22	(observations with transit instrument by Nahlik and Kühnert).
1	5	21·23	(observations in the Vertical of the Pole-star by Schram and Anton).

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Berlin—Greenwich :—

m s
53 34·92 (Nahlik, Kühnert, Becker).

Berlin—Vienna :—

m s
11 46·29 (Nahlik, Kühnert, Becker).

Greenwich—Munich :—

m s
46 26·29 (Nahlik, Kühnert, Orff).

Munich—Vienna :—

m s
18 54·97 (Nahlik, Kühnert, Orff).

The inferences from the partial results give :—

h m s s
1 5 21·23 ± 0·02.

For the difference between Pulkowa and Vienna, we have found by the telegraphic method :—

m s s
55 57·43 ± 0·02.

That between Pulkowa and Greenwich is therefore

h m s
2 1 18·66,

which agrees remarkably well with that ($2^{h}\ 1^{m}\ 18^{s}{\cdot}67$) obtained by the Chronometer expedition.

For Paris—Vienna, Löwy and I found :—

m s
56 0·22.

According to Hilgard, Paris—Greenwich is :—

m s
9 20·94.

Therefore Vienna—Greenwich would be :—

h m s
1 5 21·16,

which agrees well with the above result, assuming the tolerable accuracy of Hilgard's result.

We have, moreover :—

			h	m	s
Greenwich—Bonn, according to Forsch			0	28	23·31
Bonn—Leipzig	„	Forsch and Bruhns	0	21	10·67
Leipzig—Vienna	„	Oppolzer	0	15	47·18
Therefore, Greenwich—Vienna			1	5	21·16

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so that we shall fall into no very great error if we take

$$\overset{h}{1}\ \overset{m}{5}\ \overset{s}{21{\cdot}21}$$

for the difference of longitude between Greenwich and Vienna.

The reduction of the point of observation to the old University Observatory of Vienna is $+10^{s}{\cdot}52$. For this latter point, therefore, the difference of longitude with respect to Greenwich amounts to $1^{h}\ 5^{m}\ 31^{s}{\cdot}73$, which agrees very well with the old (*Nautical Almanac*) value; i.e. $1^{h}\ 5^{m}\ 31^{s}{\cdot}9$.* In general it would appear that the old longitudes, obtained without telegraphic operations, are not so bad as is commonly supposed.

On the Coincidence of the Bright Lines of the Oxygen Spectrum with Bright Lines in the Solar Spectrum. By Henry Draper, Esq., M.D.

I intend in this paper to speak of the steps that led to the discovery of oxygen in the Sun, to describe very briefly some of the successive improvements of the electrical and optical apparatus employed, and finally to discuss the earlier results and to show their subsequent confirmation.

In 1857, after the meeting of the British Association at Dublin, some of the members, by the kindness of the Earl of Rosse, were invited to visit the 6-foot Reflector at Birr Castle. In this way I enjoyed the advantage of seeing the methods by which that great instrument had been produced, and, on returning to America in 1858, it prompted me to begin the construction of a metallic speculum of 15½ inches aperture. Soon after, by the advice of Sir John Herschel, who had early information of Foucault's work in Paris, the metal was abandoned in favour of silvered glass, and several mirrors were ground and polished. The telescope was constructed especially for photography, and good results were obtained in 1863, culminating in the production of a photograph of the Moon 50 inches in diameter. These were published in the *Smithsonian Contributions to Science* for the succeeding year. The success procured with this instrument prepared the way for making a silvered glass Equatoreal of 28 inches aperture, which was ready for use in 1871, though it has been much modified since. It was obvious that increased light-

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* *Note by Mr. Lynn.*—Until 1872 the *Nautical Almanac* has $1^{h}\ 5^{m}\ 31^{s}{\cdot}9$; from 1873, $1^{h}\ 5^{m}\ 31^{s}{\cdot}3$, adopted from the *Berliner Astronomisches Jahrbuch* for 1870. The former value was adopted from an investigation by Professor Littrow in 1824 (*Ast. Nach.* vol. iii. p. 64), based on observations of solar eclipses and occultations made about the end of the last century. It is worthy of notice that the result of the mean of six direct comparisons between Greenwich and Vienna there given (from two eclipses of the Sun in 1787 and 1788 and four occultations of stars in *Taurus* and *Gemini* in 1786, 1788, 1791, and 1792) is $1^{h}\ 5^{m}\ 31^{s}{\cdot}78$, closely agreeing with that of Dr. Oppolzer above.